AMENDMENTS TO THE SPECIFICATION

Paragraph beginning at page 1, line 1 (before the Title):

~~DESCRIPTION~~

Please insert the following paragraph on page 1 after the title:

CROSS REFERENCE TO RELATED APPLICATIONS

The present application is a national stage of PCT/JP2004/009539, filed July 5, 2004, which claims priority to Japanese application No. 2003-195212, filed July 10, 2003.

Paragraph beginning at page 1, line 4:

~~Technical~~ Field of Invention

Paragraph beginning at page 1, line 5:

The present invention relates to a TM010 mode resonator device for oscillating ~~a~~ high-frequency electromagnetic ~~wave of~~ microwaves, millimeter waves, etc., an oscillator device, and a transmission and reception device.

Paragraph beginning at page 1, line 9:

In general, a TM010 mode resonator device having circular electrodes, opposite to each other, formed on both surfaces of a dielectric substrate is known for use in transmission and reception devices, such as communication devices and radar devices. (see ~~Patent Document 1~~, Japanese Unexamined Patent Application Publication No. 10-98316, for example).

Paragraph beginning at page 1, line 12:

~~Patent Document: Japanese Unexamined Patent Application Publication No. 10-98316.~~

Paragraph beginning at page 1, line 15:

In such a TM010 mode oscillator device according to the prior art, when compared with a TM01 mode resonator device in which a grounding electrode is

formed on the substantially whole bottom surface of the dielectric substrate, since the thickness of the dielectric substrate can be increased to about double the thickness of a substrate where the coupling to an electromagnetic field of a TM0 mode as a surface wave mode does not occur, about twice as large a conductor Q (Qc) and no load Q (Qo) can be obtained and a low loss filter becomes possible.

Paragraph beginning at page 2, line 1:

The present invention has been made in consideration of the above problem of the prior art, and it is an object of the present invention to provide a TM010 mode resonator device, an oscillator device, and a transmission and reception device ~~suppressing~~ that suppresses radiation of an electromagnetic field and ~~having~~ has a high Q.

Paragraph beginning at page 2, line 5:

In order to solve the above problem, ~~according to the present invention of claim 1,~~ a TM010 mode resonator device comprises a dielectric substrate; electrodes formed on both surfaces of the dielectric substrate, at least one of the electrodes being a circular electrode; and a plurality of through holes passing through the dielectric substrate and formed around the circular electrode in the dielectric substrate, the inside of each through hole having no electrode ~~as no electrode-formed portion~~. In the TM010 mode resonator device, an open-circuited end for improving confinement of an electromagnetic field is provided around the circular electrode by using the plurality of through holes.

Paragraph beginning at page 2, line 13:

Under such a construction, an electromagnetic field is generated by resonance in the portion of the resonator device corresponding to the circular electrode in the dielectric substrate and the electromagnetic field can be reflected totally by using the open-circuited end. Accordingly, ~~it~~ no load Q is ~~able to improve no load Q~~ improved

by suppressing radiation of the electromagnetic field and the energy confinement can be heightened.

Paragraph beginning at page 2, line 18:

Furthermore, in the present invention, a plurality of through holes passing through the dielectric substrate are formed around the circular electrode in the dielectric substrate, the inside of each through hole having no electrode ~~is made no electrode formed portion~~, and the open-circuited end is formed by the plurality of through holes.

Paragraph beginning at page 2, line 26:

In the present invention, it is desirable that, when the wavelength of a resonance frequency in the dielectric substrate is represented by λg, the space between neighboring through holes be $\lambda g/4$ or less~~. Thus, it is able~~ so as to prevent an electromagnetic field from leaking from between neighboring through holes and the energy confinement can be heightened.

Paragraph beginning at page 3, line 3:

Furthermore, in another embodiment of the present invention, a TM010 mode resonator device comprises a dielectric substrate; electrodes formed on both surfaces of the dielectric substrate, at least one of the electrodes being a circular electrode; and a plurality of strip electrodes disposed so as to radially extend around the circular electrodes formed on both surfaces or the circular electrode formed on one surface of the dielectric substrate so as to have a space between the circular electrodes or the circular electrode and the plurality of strip electrodes.

Paragraph beginning at page 3, line 9:

In this case, when the wavelength of a resonance frequency of the dielectric substrate is represented by λg, by setting the lengths of the strip electrodes at $\lambda g/4$, for

example, the tip portion (side of the outermost end) of each strip electrode can be short-circuited in a pseudo way. Alternatively, by setting the length of the strip electrodes at λg/2, for example, the tip side of each strip electrode can be open-circuited in a pseudo way. ~~At~~With this ~~time~~ configuration, since the circular electrode is enclosed by a plurality of radially disposed strip electrodes, ~~it~~ the resonator is able to make an electromagnetic field generated in the portion corresponding to the circular electrode in the dielectric substrate reflected totally at the tip side of the strip electrodes as a short-circuited end or an open-circuited end, and the energy confinement can be heightened. As a result, even if the thickness of the dielectric substrate is increased, since radiation of an electromagnetic field can be suppressed, ~~it is able to~~ the resonator simultaneously ~~improve~~ improves the conductor Q and the radiation Q and ~~to~~ effectively ~~heighten~~ heightens no load Q.

Paragraph beginning at page 4, line 1:

In the present invention, it is desirable that the space between neighboring strip electrodes be set to be λg/4 or less~~. Thus, it is able~~ so as to prevent an electromagnetic field from leaking from between neighboring strip electrodes and to heighten the energy confinement.

Paragraph beginning at page 4, line 4:

Furthermore, an oscillator device may be ~~constituted~~ formed by using a TM010 mode resonator according to the present invention and also a transmission and reception device, such as a radar device and communication device., by using an oscillator device according to the present invention.

Paragraph beginning at page 4, line 21:

Fig. 6 is an enlarged top view of ~~an essential part,~~ a strip electrode at location a in Fig. 5.

Paragraph beginning at page 4, line25:

Fig. 8 is ~~characteristic lines~~ a graph showing the relation between the space height from the TM010 mode resonator device in Fig. 7 to the cavity and the coefficient of variation of the resonance frequency.

Paragraph beginning at page 4, line 28:

Fig. 9 is an enlarged top view of ~~an essential part, at the same position as that in Fig. 6,~~ a strip electrode of a first modified example at the same position as that in Fig. 6.

Paragraph beginning at page 5, line 2:

Fig. 10 is an enlarged top view of ~~an essential part, at the same position as that in Fig. 6,~~ a strip electrode of a second modified example at the same position as that in Fig. 6.

Paragraph beginning at page 5, line 4:

Fig. 11 is an enlarged top view of ~~an essential part, at the same position as that in Fig. 6,~~ a strip electrode of a third modified example at the same position as that in Fig. 6.

Paragraph beginning at page 5, line 6:

Fig. 12 is an enlarged top view of ~~an essential part, at the same position as that in Fig. 6,~~ a strip electrode of a fourth modified example at the same position as that in Fig. 6.

Paragraph beginning at page 5, line 8:

Fig. 13 is an enlarged top view of ~~an essential part, at the same position as that in Fig. 6,~~ a strip electrode of a fifth modified example at the same position as that in Fig. 6.

Paragraph beginning at page 5, line 10:

Fig. 14 is an enlarged top view of ~~an essential part, at the same position as that in Fig. 6,~~ a strip electrode of a sixth modified example at the same position as that in Fig. 6.

Paragraph beginning at page 5, line 12:

Fig. 15 is an enlarged top view of ~~an essential part, at the same position as that in Fig. 6,~~ a strip electrode of a seventh modified example at the same position as that in Fig. 6.

Paragraph beginning at page 5, line 16:

Fig. 17 is an enlarged top view of ~~an essential part,~~ a strip electrode at location b in Fig. 16.

Paragraph beginning at page 5, line 18:

Fig. 18 is an enlarged top view of ~~an essential part, at the same position as that in Fig. 17,~~ a strip electrode of an eighth modified example at the same position as that in Fig. 17.

Paragraph beginning at page 5, line 20:

Fig. 19 is an enlarged top view of ~~an essential part, at the same position as that in Fig. 17,~~ a strip electrode of a ninth modified example at the same position as that in Fig. 17.

Paragraph beginning at page 6, line 7:

~~Best Mode for Carrying Out~~Detailed Description of the Invention

Paragraph beginning at page 7, line 4:

Reference numeral 3 represents a plurality (twelve, for example) of through holes formed along the periphery of the resonator electrodes 2A and 2B so as to pass through the dielectric substrate 1, and the inner wall surface 3A (inner portion) of each through hole ~~is no~~ does not have an electrode ~~formed portion where no electrode is contained.~~. Furthermore, the space P0 (pitch) between neighboring through holes 3 is set to be 1/4 or less of the wavelength λg of the resonance frequency in the dielectric substrate 1 ($P0 \leq \lambda g/4$). The ~~Then, the~~ plurality of through holes 3 are disposed so as to

enclose the resonator electrodes 2A and 2B and the through holes 3 form an open-circuited end as a whole.

Paragraph beginning at page 9, line 28:

Here, in order to improve no load Q (Qo) of the TM010 mode resonator 12, there is a method of increasing the thickness of the dielectric substrate 11 in addition to a method of decreasing the radiation loss. This is because the conductor Q (Qc) is represented by the ratio of the thickness t of the dielectric substrate 11 to the skin depth δ ($Qc = t/\delta$). For example, when the thickness t of the dielectric substrate 11 is 0.6 mm ($t = 0.6$ mm) and the skin depth δ is 0.6 μm ($\delta = 0.6$ μm), the conductor Q (Qc) becomes 1000 ($Qc = 1000$). In this way, when the thickness t of the dielectric substrate 11 increases, ~~it is able to improve~~ the conductor Q (Qc) is improved, but, in contrast with this, there is a tendency ~~to increase~~ for the radiation loss to increase.

Paragraph beginning at page 10, line 11:

Contrary to this, in the present embodiment, since pluralities of strip electrodes 13 and 14 radially extending so as to enclose the resonator electrodes 12A and 12B are formed on the top surface 11A and bottom surface 11B of the dielectric substrate 11, the tip sides of the strip electrodes 13 and 14 ~~is~~ are short-circuited in a pseudo way and the electric field can be concentrated between the resonator electrodes 12A and 12B. Because of this, in the present embodiment, ~~a~~ magnetic field energy can be confined and the radiation of an electromagnetic field can be suppressed.

Paragraph beginning at page 10, line 18:

In order to confirm the effect of suppression of radiation by such strip electrodes 13 and 14, the cases in which a resonator device having strip electrodes 13 and 14 and a resonator device not having strip electrodes 13 and 14 are contained inside a cavity 15 of a substantially square box-like space, respectively, were ~~assumed~~ simulated (see Fig. 7). In each resonator device, the coefficient of variation $\Delta f/f0$ of a resonance frequency

when the space height of the upper portion of the cavity 15 (side of the top surface 11A of the dielectric substrate 11) was changed was calculated by using a three-dimensional electromagnetic field simulation. The result is shown in Fig. 8.

Paragraph beginning at page 11, line 8:

Furthermore, the dielectric substrate 11 is disposed in the middle of the cavity 15 ~~so as to be floated~~. Practically, the dielectric substrate 11 is disposed on a support made of a low dielectric material so as not to affect the resonance characteristics of the TM010 mode resonator 12.

Paragraph beginning at page 11, line 12:

From the result in Fig. 8, when strip electrodes 13 and 14 are formed as in the present embodiment, ~~when~~ as compared ~~with the case~~ to a resonator in which the strip electrodes 13 and 14 are ~~eliminated~~ not formed, it is understood that the variation of the resonance frequency F0 is small even if the height h of the space of the cavity 15 is changed. That is, since the radiation of an electromagnetic field in the case where the strip electrodes 13 and 14 are formed is smaller than in the case where the strip electrodes are ~~eliminated~~ not formed, it is understood that the effect of the cavity 15 is little and ~~it was able to confirm~~ the effect of suppression of radiation by the strip electrodes 13 and 14 was confirmed.

Paragraph beginning at page 12, line 1:

As a result, even if the thickness of the dielectric substrate 11 is increased, since the radiation of an electromagnetic field between the resonator electrodes 12A and 12B can be suppressed, both conductor Q (Qc) and radiation Q (Qr) can be simultaneously improved and ~~it is able to heighten~~ no load Q (Qo) of the TM010 mode resonator 12 is heightened.

Paragraph beginning at page 12, line 5:

Furthermore, since the space P1 between neighboring strip electrodes 13 and 14 is set to be 1/4 or less of the wavelength λg of the resonance frequency ($P1 \leq \lambda g/4$), ~~it is able to prevent~~ an electromagnetic field is prevented from leaking from between neighboring strip electrodes 13 and 14 and ~~to increase the~~ energy confinement is increased.

Paragraph beginning at page 12, line 23:

Next, Figs. 16 and 17 show a TM010 mode resonator device according to a third embodiment and ~~the present embodiment~~ is characterized in that strip electrodes are of a stepped impedance type in which the impedance changes in a stepwise manner in the middle of the length direction of the strip electrodes. Moreover, in the present embodiment, the same reference numerals are given the same components as in the second embodiment and their description is omitted.

Paragraph beginning at page 14, line 9:

Furthermore, in the second and third embodiments, the strip electrodes 13, 14, 21 to 27, and 31 to 33 are formed on both of the top surface 11A and bottom surface 11B of the dielectric substrate 11. However, the present invention is not limited these, and, for example, strip electrodes may be formed only on ~~either~~ one of the top surface and bottom surface of a dielectric substrate. In this case, it is considered that the effect of radiation suppression of an electromagnetic field is reduced by half.

Paragraph beginning at page 14, line 21:

Next, Figs. 20 and 21 show a fourth embodiment of the present invention, and the present embodiment is characterized in that an oscillator device is ~~constituted by~~ formed using a TM010 mode resonator device of the present invention. Moreover, in the present embodiment, the same reference numerals are given the same components as in the first embodiment and their description is omitted.